component at a marginal cost of $.05 or less will be able to meet the incumbent's price and survive.

ECP provides a firm methodological basis for pricing interconnection for LEC competitors in the evolving "network of networks" as long as economies of scale prevent the emergence of fully integrated competitors and complete deregulation of local telecommunications services.

In the following section we shall examine in more detail the impact on LECs serving rural areas (who must interconnect with the network capabilities located in urban exchanges) of local exchange competition, unbundling, and nondiscriminatory pricing of shared facilities in urban areas.

III. Rural LECs Must Be Allowed to Share Advanced Telecommunications Infrastructure With Larger, Urban LECs on a Co-Carrier Basis

The unbundled pricing of local exchange facilities to potential competitors is a relatively new phenomenon.[31] However, LECs with urban exchanges have long made various exchange capabilities available

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[31] See, e.g., "FCC Proposes Third Party Mediated Access to LECs' Intelligent Networks," FCC News Release (Aug. 3, 1993) (designed to ensure that LECs' networks are open to encourage the interworking of competitive intelligent networks); "Rules Adopted for Expanded Interconnection for Switched Transport," supra.

on a "wholesale" basis to other LECs with which they had "co-carrier" relationships. It is important for policy makers to recognize that fundamentally different pricing principles apply to the two situations. Offering unbundled use to potential urban competitors need not disturb the pricing arrangements under which such use is offered to neighboring rural carriers which cooperate to provide joint services. In particular, the principle of nondiscriminatory, unbundled pricing does *not* require that potential urban competitors and rural co-carriers be charged the same rates for use of unbundled shared components of urban networks. Indeed, from an optimal pricing perspective, rural co-carriers should typically receive a discount relative to the unbundled rates charged potential urban competitors.

To fully exploit economies of scale and preserve reasonable rates, rural LECs must be allowed to share advanced telecommunications infrastructure with larger, urban LECs on favorable terms. Rural LECs and urban LECs are not competitors but instead share a unique co-carrier relationship, a relationship based on partnership to provide customers everywhere with end-to-end telecommunications service. Such pricing for rural LECs is consistent with fair competition between urban LECs and urban competitors.

Joint network planning and operation between larger, urban LECs and smaller, rural LECs would reduce modernization costs, deter uneconomic bypass, and preserve revenues needed for universal service. A 1991 report by the Congressional Office of Technology Assessment (OTA) strongly supports the idea of joint provisioning of telecommunications infrastructure throughout small exchange and low-density areas.[32] Large urban LECs should be the driving force in developing and implementing advanced facilities and services nationwide and can play a key role in joint LEC planning of network upgrades. Their economies of scale and financial resources are far superior to those of rural LECs. In addition, some have a direct share in research and development organizations (e.g., the BOCs have Bell Communications Research ("BellCore")).

The small switches applicable to rural LECs in low-density areas do not have presently, and may not have in the future, all of the advanced capabilities (e.g., certain SS7 functionalities) of the larger switches applicable to urban service areas. Accordingly, both houses of the U.S. Congress have introduced bills that embrace infrastructure sharing. Senate Bill S.570 and House Bill H.R.1312, both entitled the

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[32] Congress of the United States, Office of Technology Assessment, Rural America at the Crossroads: Networking for the Future at 82, 127, 129 (1991) ("OTA Report"). See also Panzar, supra.

"Local Exchange Infrastructure Modernization Act of 1993," would require the FCC to develop rules that require a LEC to share public switched network infrastructure and functionality with requesting LECs "lacking economies of scale or scope." The legislation would limit the privilege of infrastructure sharing to LECs because LECs are the only carriers with universal service obligations. In addition, the bills would amend the Communications Act of 1934 to ensure (1) universal service at reasonable rates, (2) universal availability of advanced network capabilities and information services, (3) a consistent and feature-rich access network, enabling seamless national communications capabilities, and (4) high quality and reliability standards for advanced network services.

Testifying before the Senate Commerce Committee on another Senate bill (S.1086) entitled the "Telecommunications Infrastructure Act of 1993", Gary McBee, Vice Chairman of the United States Telephone Association ("USTA"), stated that

> Congress should provide local exchange carriers with the statutory authority to share network functions and facilities with each other so as to maximize the availability of the benefits of the public telephone network. . . . [P]roviding LECs with the statutory authority to share network functionalities and facilities . . . would ensure small rural ex-

changes can provide their consumers the same service choices available to urban consumers.[33]

Similarly, Lawrence Ware, manager of the Garden Valley Telephone Company in Erskine, Minnesota, testified on behalf of the Rural Telephone Coalition that rural LECs should be allowed to share the infrastructure of urban LECs at prices below that charged to an urban LEC's competitors:

> Mandating planning and infrastructure sharing by neighboring LECs that collectively make up the only nationwide regulated network which provides universal service, is different from requiring sharing among regulated LECs and their largely unregulated competitors, which serve only the locations and customers they choose. Treating carriers with different obligations and motives as if they are the same is just as unreasonable as treating identical carriers differently.[34]

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[33] Testimony of Gary McBee on S.1086 Before Senate Commerce Committee at 4, 12 (July 14, 1993).

[34] Testimony of Lawrence Ware on S. 1086 Before Senate Commerce Committee at 28 (July 14, 1993).

> [Joint] LEC planning and infrastructure sharing are essential to the availability of new technology and services in the rural U.S. . . . Through infrastructure sharing, small and rural LECs would be able to share information and technology with larger telephone companies, making it far more economical to offer a full array of advanced telecommunications services to their customers.

Id. at 24, 26.

(continued...)

Large urban LECs should make their SS7 and other advanced facilities available to neighboring LEC co-carriers on reasonable terms and conditions without being required to offer those same terms to potential competitors. This policy recognizes the unique role of the core LEC public switched network.

Of particular concern for the future development of the telecommunications infrastructure is a situation in which one of the service components offered under an urban LEC's competitive unbundling proposal is an important infrastructure enhancement capabili-

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[34](...continued)

> Infrastructure sharing is not a new concept. For example, some small LECs use a larger LEC's tandem switch to deliver traffic to interexchange carriers. However, as new network technologies are introduced and competition develops, it is essential for public policy to ensure that necessary infrastructure sharing continues to protect customers in areas where competitive choices will become available slowly, if ever. It is not economically feasible to install vast databases and advanced switching equipment in some rural areas. This does not mean, however, that rural communities must go without advanced services. Using fiber optics and other transmission media, LECs serving rural areas can access the databases and advanced switches that larger LECs install in more populous areas.

Id. at 27.

ty and faces less competition than other service components. Examples include SS7 or the data bases needed to implement such enhanced features. Competitors have indicated that use of such capabilities is an important part of any proposal for local exchange competition.[35] However, it is often the case that it is most economical for rural LECs to share such facilities with neighboring urban LECs in order to fully exploit economies of scale. Under what terms should such use be granted to rural LECs? Should they be charged the same contribution-preserving rate as potential competitors? What does "nondiscriminatory use" mean in such circumstances?

It turns out that a complete analysis of this pricing issue is somewhat complex. This is because the shared service component is an essential intermediate input to multiple final services. In particular, the service component is an essential input of local exchange services within the urban LEC's franchise area, as well as interarea service in partnership with the rural LEC. Appropriate benchmarks for pricing monopoly services are the prices which would be set by a regulatory authority whose objective is the maximization of total economic surplus subject to the constraint that both the urban and rural LECs cover their costs. The

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[35] The ALTS White Paper, supra (at 5) identifies these as bottleneck facilities.

simplest such model capable of shedding light on the issue is presented in Appendix E. Even this gives rise to some complex algebra. Here, we merely summarize and illustrate some of the main results.

The relationship between the usage charges paid by rural LECs (or their customers) and potential urban competitors depends on several factors. To provide an intelligible baseline, consider the "benchmark case" in which the joint service and the urban intraexchange service have the same price sensitivity of demand, and rates for the joint service and the urban intraexchange service are equal. Then, optimal pricing for use of the service component facing less competition results in rates for rural LECs and their customers which are below those charged to urban competitors. The difference between these charges increases as:

1. The urban intraexchange demand is less price sensitive relative to the rural intraexchange demand;

2. The rural LEC's ability to generate revenues relative to the costs of providing service is less than that of the urban LEC; and

3. The urban intraexchange rate is higher relative to the joint service rate.

This analysis has revealed that the unbundling of urban LECs' services should not mean that rural LECs are "just another cus-

tomer" for these services. On the contrary, their status as partners of urban LECs in the provision of end-to-end joint services requires that the arrangements under which rural LECs and their customers share network facilities be different from those of potential competitors of the urban LEC. While the optimal rates depend in a complicated way on a variety of parameters, the typical arrangements for shared service components for rural LECs and their customers should cost less than those charged to competitors under ECP.

The following example illustrates the importance of the analysis of this section and illustrates in particular the reason why urban LECs are likely to require a lower contribution towards the cost of shared network capabilities from rural LECs than from urban LECs' direct competitors:

EXAMPLE 4

> An urban LEC serving 100,000 customers introduces an advanced service. This service involves fixed costs of $2,000,000 per period plus a marginal cost of $.25 per minute of use. This marginal cost is composed of $.15 per minute of use of the advanced network facilities plus $.10 per minute for use of other network components. Each customer demands 100 minutes per period, which they

value at $.50 per minute. In order to break even, the urban LEC must price this service at $.45 per minute.[36]

If a potential competitor demands access to the advanced network facility, the appropriate access price under ECP would be $.35, the difference between the total enhanced service price of $.45 and the $.10 the LEC saves by having the entrant provide the competitive service components. As our earlier analysis indicated, this pricing policy will allow the entrant to offer the enhanced service only to those customers for whom it is the least-cost provider of the competitive service components.

Now suppose there is a neighboring rural LEC which wishes to offer the advanced service to each of its 1000 customers, each of whom also demands 100 minutes per period, valued at $.50 per minute. The rural LEC could not remotely consider acquiring the necessary facilities itself. (A price of $20 per minute would be required just to cover the fixed costs!) However, given access to the urban LEC's facility, it calculates that it could provide the advanced service to its customers at an additional cost of $.20 per minute.

What price should the urban LEC charge the rural LEC for access to the shared network components of the advanced service? First, consider the $.35 ECP rate offered to potential competitors. At that access rate, the lowest price at which the rural LEC could offer the advanced service to its customers and still cover its costs would be $.55 ($.35 + $.20) per minute. Since this is greater than the willingness to pay for the service, the advanced service would not be offered in the rural area.

Consider instead the result if the rural LEC is offered a "co-carrier" charge of $.25 per minute. Now, the rural LEC can offer its customers an enhanced service rate of $.45 per

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36 Average cost equals total costs divided by 10,000,000 minutes per period. Total costs equal fixed costs of $2,000,000 plus variable costs of $2,500,000.

minute, yielding them a consumers' surplus of $.05 per minute. The urban LEC gains another source of contribution to cover the fixed costs of the advanced service, an amount equal to ($.25-$.15)(1000)(100) = $10,000 in this example. In fact, all parties can be made better off at any co-carrier usage rate between $.15 (marginal cost) and $.30 (the highest rate at which rural participation can occur). Note that, unlike in Example 1, it is not assumed that urban users benefit directly from rural participation via a network externality. Here, the mutual benefits result from more fully exploiting economies of scale and scope. Obviously, the network externalities associated with the advanced service would only strengthen the point of the example.

Finally, we would like to point out that this analysis of infrastructure sharing is not limited to *inter-firm* transactions between urban and rural LECs. The same issues must be addressed when a single LEC provides infrastructure enhancements to be shared by its urban and rural exchanges.

Suppose that the urban and rural exchanges of Example 4 belonged to a BOC. How should the BOC go about pricing the enhanced service?

For this example, it turns out that there are a wide range of combinations of urban and rural prices which result in an efficient outcome. Efficient prices in the rural exchange range between $.35 (rural marginal cost) and $.50 (the highest rate at which rural participation can occur). This is the same efficient price range as in the case where the urban and rural exchanges are operated by different LECs. The corresponding prices in the urban exchange, calculated to allow the BOC to just cover the costs of the enhancement, range between $.45 and $.4485. If rate averaging is applied, the BOC would charge both its urban and rural

customers (slightly more than) $.449. Now consider the issues raised if the BOC were to offer the services of the less competitive service component on an unbundled basis. The ECP offered to potential urban exchange competitors would be $.349 = $.449-$.10. Yet potential competitors could, correctly, claim that the *imputed* usage price charged to rural exchange customers was only $.249 = $.449-$.20 under rate averaging. Indeed, due to the higher cost of providing rural service, all efficient rural exchange prices in this example imply imputed usage prices that are below the ECP usage prices charged to urban competitors.

It is the presence of high-cost rural exchanges that may give rise to the necessity for smaller explicit or implicit contributions from LECs serving rural customers, regardless of whether they are served by a BOC or a small rural LEC.

Conclusions and Policy Recommendations

In response to growth in urban markets and advances in telecommunications technology, we have seen growing competition in urban markets for the services offered by the established franchised LECs. Some policymakers have been encouraging this competition and it now appears likely that a wide variety of local services will be supplied competitively in the larger markets in the future.

It is important that the interests of rural subscribers not be shortchanged in an enthusiastic rush to promote competition in urban areas. The adverse cost and income conditions that have made support for rural telephony and the provision of rural service by franchised monopolies necessary in the past still exist today. This support and protection against competitive entry must be continued to maintain rural service and to ensure that rural residents also share in the benefits of new technologies and services. Furthermore, urban customers also benefit from the inclusion of rural subscribers as full participants in the switched network.

While the enthusiasm for the prospects for competition in urban areas is understandable, little attention has been paid to the special circumstances under which telephone services are provided in

rural areas. We see three potential threats to the integrity of rural service in current trends.

The first danger is that policymakers will try to promote exchange competition in rural areas. Proposals to this effect have already been floated, and we feel they reflect an incomplete understanding of the consequences of competition to rural LECs who must serve low-density, high-cost areas with a technology characterized by strong scale economies, and are therefore dependent on external support. Competition in rural areas would encourage inefficient cream-skimming, a consequence of which will be an increase in the support from the rest of the telecommunications industry required to maintain service to those rural telephone customers (mostly residential) least likely to be served by competitive entrants.

Tying support payments to individual customers for whom rural LECs would compete, as the N.Y. PSC has tentatively proposed, would exacerbate these problems. If support payments were large enough to make rural customers attractive targets of opportunity for competitive entrants, a portion of that support would be competed away in lower prices and not used to defray the costs of rural service -- necessitating a further increase in external support to maintain reason-

ably priced service for all rural residents. For this reason it is important that the integrity of rural LEC franchises be maintained.

The second threat is the possibility that funding for the within-industry transfers that have been so important to the provision of rural service in the past will not be maintained as competition in urban areas intensifies. Since divestiture, these transfers have occurred partially through levies on rates for LEC switched access services. But levies of this sort are a source of competitive advantage to LECs' access service competitors. Artificial advantages of this sort are not compatible with full-blown competition and will have to be eliminated to allow the BOCs and other urban LECs to compete on equal terms with alternative service providers. Therefore, other mechanisms must be implemented for collecting the funds that support rural telephone services. A particularly attractive mechanism, which is similar to the mechanism used to finance the current Universal Service Fund, is bulk billing to IXCs, such as charges based on each IXC's revenues or presubscribed access lines. Bulk billing has the important advantages of not distorting relative prices and consumption decisions in final output markets while permitting cost-based competition to flourish where possible in services such as access transport. Applications of Baumol's ECP principles might also be used to

promote urban exchange competition while preserving contributions to LEC overhead and various social transfers.

The third potential threat to rural service that we see in the push for competition in telecommunications services in urban areas is that urban LECs will charge rural LECs the same prices for interconnection and use of various advanced network capabilities that they charge their local market competitors. Urban LECs should continue as partners with rural LECs in the provision of joint services. Cooperation between rural and urban LECs is necessary to achieve beneficial economies of scale, and efficiency requires lower prices for rural LECs in most circumstances.

Appendix A

Operating Conditions of Small, Rural LECs

Telephone subscribers nationwide depend on LECs that vary in many dimensions -- size; subscriber demographics; operations; costs; network technologies employed; and dependence on toll and access revenues. These different characteristics are discussed in detail below.

Size. At the beginning of 1992, the Bell Companies ("BOCs"), on average, accounted for approximately 72 percent of the LEC access lines in the nation and provided local exchange services in most of the metropolitan areas.[1] In contrast, small and mid-sized LECs participating in the National Exchange Carrier Association ("NECA") pool accounted for only five percent of access lines.[2]

Through 1991, BOCs had invested $192.8 billion in total plant in service compared to just $14.0 billion invested by LECs borrowing from the Rural Electrification Administration ("REA"). In addition, BOCs reported in 1991 $3.01 billion in total plant under construction

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1 National Exchange Carrier Association, Modernizing Rural America -- Investments in New Technologies by Small Telephone Companies at 5 (1992) ("NECA Study").

2 Id.

compared to $418.4 million for REA LECs.[3] BOC operating revenues in 1991 were $67.9 billion while REA LECs operating revenues were only $4.4 billion.[4]

Subscriber Demographics. LECs differ in the demographics of their subscribers, such as income and age distribution. People living in rural areas on average have significantly lower annual income than people living in metropolitan areas. Based on 1990 data, the average per capita income in the metropolitan statistical areas is $15,442, compared to only $10,904 in non-metropolitan areas.[5]

Despite lower income levels, rural consumers devote a higher percentage of expenditures to telephone services.[6] Since 1984, telephone expenditures by rural households have increased faster than expenditures by urban households. The faster growth in telephone

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3 Rural Electrification Administration, U.S. Department of Agriculture, 1991 Statistical Report, Rural Telephone Borrowers at xxxiv (1992) ("REA Report"); Federal Communications Commission, Statistics of Communications Common Carriers at 26 (1991/92) ("FCC Report").

4 REA Report at xxxviii; FCC Report at 40.

5 Bureau of the Census, U.S. Department of Commerce (1990).

6 J. Lande, Industry Analysis Division, Federal Communications Commission, REFERENCE BOOK: Rates, Price Indexes, and Household Expenditures For Telephone Service at 41 (May 1993) ("Reference Book").

expenditures by rural consumers is primarily due to an increased use of toll services.[7]

Business subscribers account for 33 percent of the total access lines of the BOCs[8] compared to only 18 percent of the access lines of LECs participating in the NECA pool[9] and 17 percent of LECs borrowing from the REA.[10] Furthermore, most business subscribers in rural areas purchase low-usage single lines. Multi-line business access lines, which are characterized by high usage, represent only eight percent of the NECA pool. In contrast, multi-line business access lines represent approximately 25 percent of the access lines of Tier 1 LECs.[11]

Additional comparisons between urban and rural demographics are provided in Appendix B.

Operations. Figures for 1991 are illustrative of the operations and cost disparities among LECs. BOCs served on average

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7 Id. at 29, 41.

8 United States Telephone Association, Statistics of the Local Exchange Carriers For the Year 1991 at 11 (1992) ("USTA Report").

9 NECA Study at 6.

10 REA Report at xxxii.

11 1992 NECA Data.

4,931,704 access lines,[12] compared to about 6,468 access lines per company for REA LECs.[13] Similarly, the average number of access lines per study area in the NECA pool is 5,600 (median 1,720), whereas Tier 1 study areas average 1.2 million access lines (median 500,000+).[14]

Half of the 5,592 central offices operated by the 1,000+ NECA LECs serve less than 500 access lines, which is five percent of the BOC average central office size.[15] And about 1,000 of the central offices operated by NECA LECs serve 200 or fewer lines, two percent of the BOC average.[16] Furthermore, NECA LECs accounted for 28 percent of central offices[17] but only five percent of access lines.[18] Similarly, REA

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12 USTA Report at 11.

13 REA Report at xxxii.

14 1992 NECA Data.

15 Rural Telephone Coalition, U.S. Telecommunications Policy Must Treat Rural Areas Differently at note 7 (undated) ("Rural Telephone Coalition").

16 Id.

17 NECA Study at 7.

18 Id. at 5.

LECs accounted for 37 percent of the nation's land area but only 4.3 percent of the nation's customers.[19]

Small LECs on average have longer loops than large companies, as they serve more rural areas. Smaller LECs have less ability to achieve economies of scale and concentrate traffic when adding lines. Similarly, the REA LECs clearly have a lower density of subscribers and smaller exchanges than do the BOCs:

Group	Average Subscriber Density Per Route Mile	Average Access Lines Per Exchange
BOC	130*	11,466*
Independents	n/a	3,081*
REA LECs	6**	1,012***

Source:

* USTA Report at 11.
** REA Report at xxxiii.
*** Rural Telephone Coalition at 2.

Furthermore, many small and rural LECs serve a single exchange and therefore cannot average rates over multiple exchanges.

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[19] REA: A Program for Rural Americans (1991).

This means that rates may be relatively low in areas with older network hardware, but rates may jump significantly the year a small LEC replaces its central office switch.[20]

There is a substantial difference in volume between metropolitan and rural areas. Tier 1 LECs have an average of over 30 percent more minutes-of-use ("MOU") per line and over ten times more MOU per central office than NECA LECs.[21] Additionally, a Southwestern Bell Telephone ("SWBT") study demonstrated that rural areas are low-volume areas. The study found that approximately 13 percent of its routes, located exclusively in urban areas, carry 91 percent of its transport minutes, with the remaining 87 percent of its routes, primarily located in rural areas, carrying just 9 percent.[22] The study concluded:

> Volumes vary substantially by route depending on the demographic nature of the serving area . . . . [V]olumes for transport services to offices within metropolitan areas and some suburban areas are high due to the higher population densities and concentration of businesses in these areas compared with small towns and rural areas.[23]

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20 Reference Book at 26.

21 1992 NECA Data.

22 Comments of Southwestern Bell Telephone Company, In the Matter of Transport Rate Structure and Pricing, CC Docket No. 91-213 at 39-40 (Feb. 1, 1993) ("SWBT Comments").

23 Id. at 40.

Costs. Smaller LECs generally have higher average capital and operating costs per access line than larger LECs. The cost disparities are attributable to the differences in operating conditions -- lower subscriber densities, smaller exchanges and fewer business users -- with no evidence of smaller LECS being less efficient.

Group	Average Annual Total Operations Expenses Per Access Line	Average Total Plant in Service Per Access Line
BOCs	$498*	$1,889*
REA LECs	$592**	$2,404**

Source:

* FCC Report at 17, 26, 42.

** REA Report at xxxii, xxxiv, xxxviii.

Furthermore, the monthly average loop cost per access line is $45.50 for cost-company LECs with less than 1,000 access lines, but only $18.90 for Tier 1 LECs.[24]

The difference between costs for high-volume offices, primarily located in urban areas, and low-volume offices, located in rural

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[24] 1992 NECA Data.

areas, can be dramatic. For example, SWBT's highest volume offices have a cost per minute for transport services of $.002040 compared with a cost per minute of $.020286 for the lowest volume offices, which is almost ten times greater.[25]

The federal Universal Service Fund ("USF") and long-term support flows are important mechanisms that help reduce these cost disparities. The USF is funded by the interexchange carriers ("IXCs") serving .05 percent or more of all presubscribed lines. These IXCs pay a fixed charge per presubscribed line per month.[26] The USF targets small and rural LECs because these LECs face higher costs. USF funds are used to reduce (1) 75 percent of the operating costs of LECs with operating costs that are 150 percent or more than the national average, (2) 65 percent of the operating costs of LECs with operating costs that are 115-150 percent of the national average, and (3) none of the operating costs of other LECs.[27] Approximately 86 percent of USF funds goes to

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25 SWBT Comments at 41.

26 Federal-State Joint Board Staff, Monitoring Report -- CC Docket No. 87-339 at 430 (May 1993) ("Monitoring Report").

As of June 30, 1991, there were 24 IXCs subject to the charge and there were 132 million presubscribed lines nationwide. Id.

27 Monitoring Report at 73.

telephone service areas with under 200,000 loops. On average, $6.74 per loop per month goes to service areas containing less than 200,000 loops, while $0.28 per loop per month goes to service areas containing over 200,000 loops.[28] USF funding only covers approximately two percent of unseparated non-traffic sensitive ("NTS") revenue requirement nationwide.[29] In addition, the contribution IXCs make to the USF amounts to only $0.00377 per interstate minute or 1.3 percent of IXC toll revenue.[30]

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28 USF Discussion Paper at 7 (April 30, 1993).

29 Monitoring Report at 75.

30 National Telephone Cooperative Association, Universal Service Fund Discussion of Issues 9 (July 1993); Monitoring Report at 75; FCC Report at 6, Table 1.3.